HR-CHESS2 update

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Design Update

- Almost done with Top-Level schematic simulation, seem to be able to detect and read out up to 8-hits within 1 BX across all process corners from a 32x128 array.

- Plan to start layout of the different blocks early this month, starting with with the digital STRIP encoding block. Still waiting on test results from HR-CHESS1 chip to get an idea of the pixel/segment geometry so hope to start optimisation and layout of the pre-amplifier/analogue front-end for from HR-CHESS2 in early October.

- Plan to organise a Design Review in September, preparing documentation.

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Response to Questions

1. In the list of spec it was mentioned that the epi thickness is up to 25µm, is this a strong limit?

No this is not a strong limit, we can increase the thickness to collect more signal.

2. Given your pixel volume are you sure a leakage current tolerance of 10nA is sufficient?

Not completely sure, it is based on what the test engineers measured for similar structures. But the leakage current tolerance of the pre-amplifier increases up to 1µA if the temp is decreased to -40°C. See results later.

3. Are you worried about hit-processing in 25ns?

No. But with the design I have, I can correctly detect max 8-hits if I reserve 2 BX periods for the STRIP ENCODING block. Ultimately I read-out the 8 hits in 25 ns or 1BX. It is a synchronous system and the delay is well characterised for the blocks.

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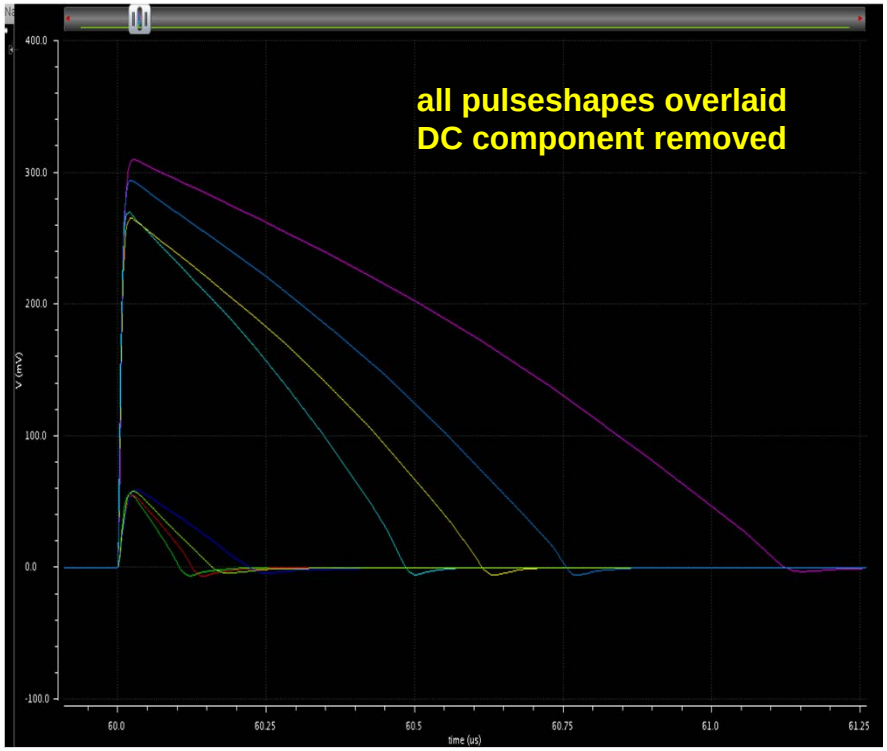
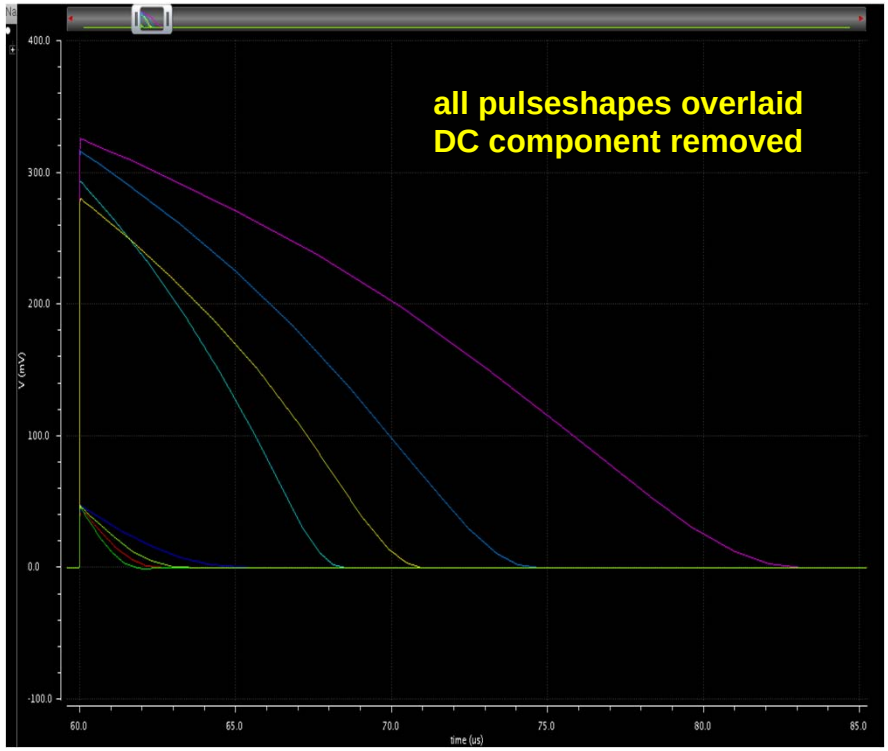
Pre-Amplifier performance





T = +40° **T = -40°**

- Signal at Pre-Amp output from 500e- to 5Ke- in 2 steps
- All process corners
- Ileakage = 0A

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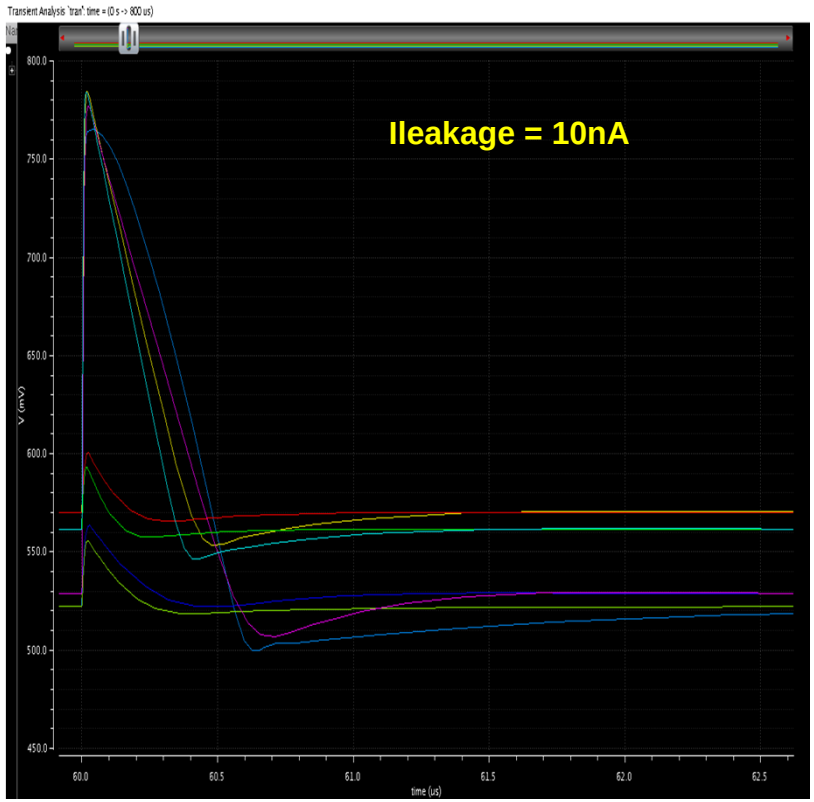
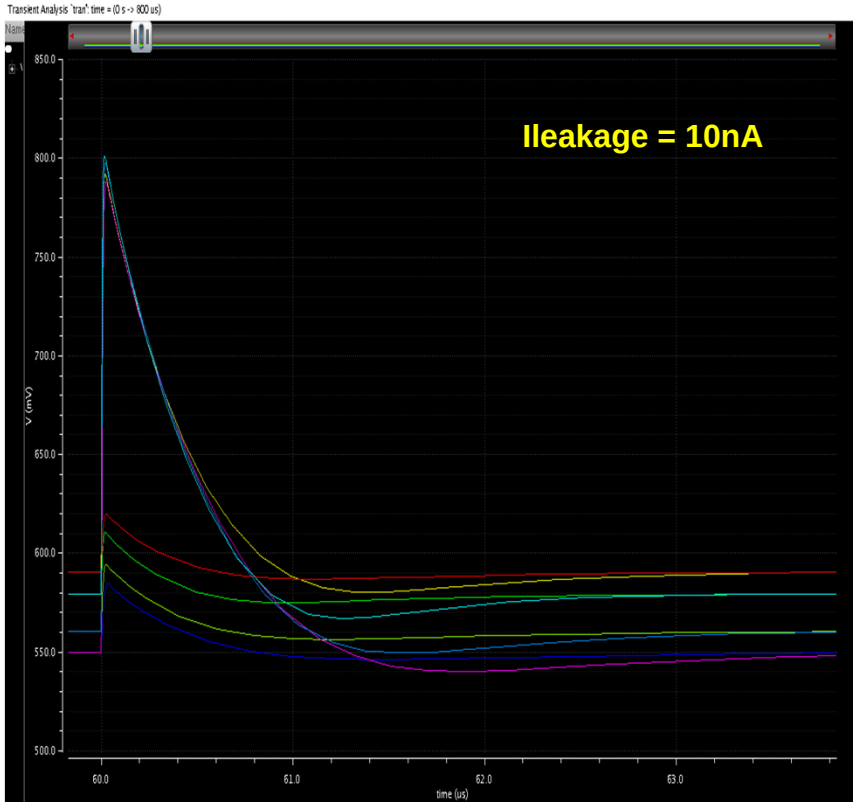
Pre-Amplifier performance with leakage current





T = +40°

T = -40°

- Signal at Pre-Amp output from 500e- to 5Ke- in 2 steps
- All process corners

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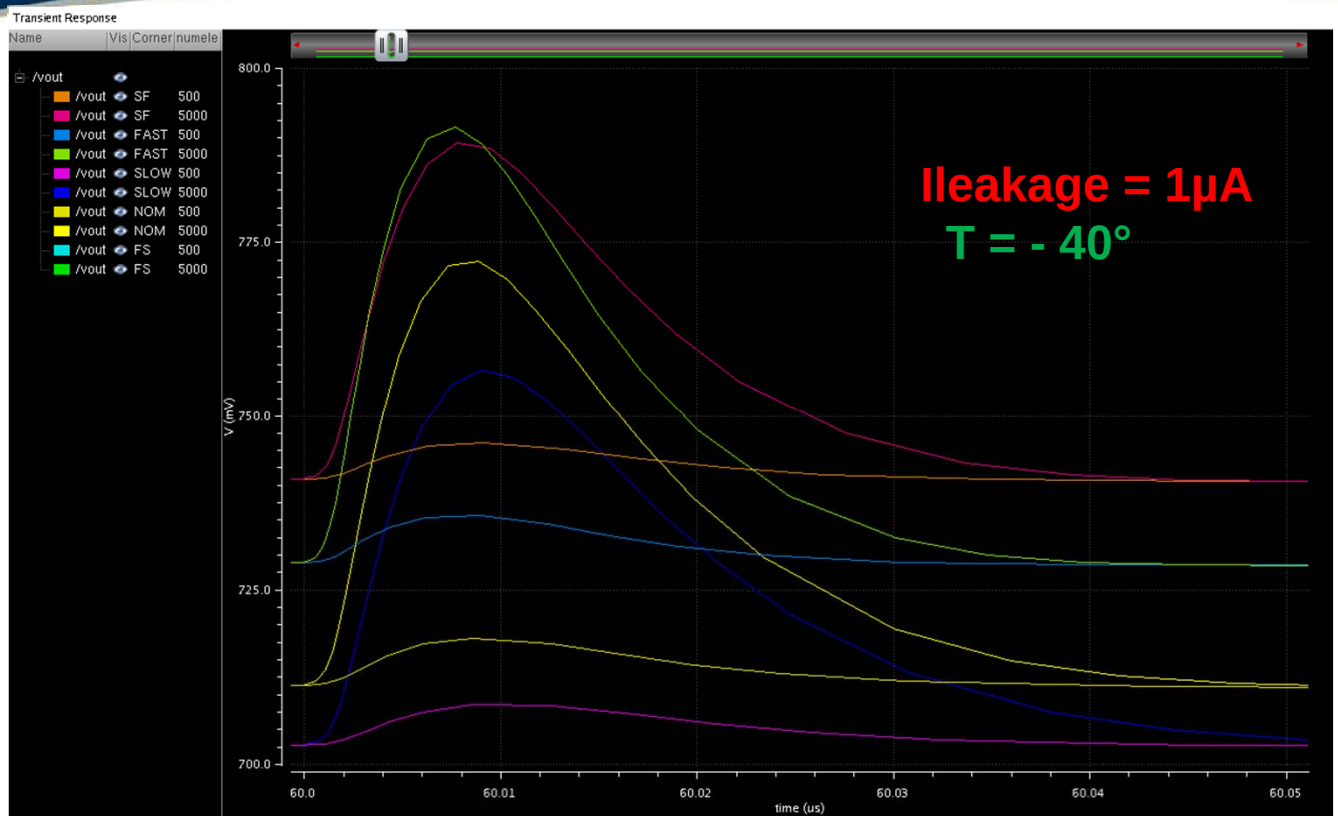
Pre-Amplifier performance with leakage current



- Signal at Pre-Amp output from 500e- to 5Ke- in 2 steps
- All process corners
- *Gain drops significantly*

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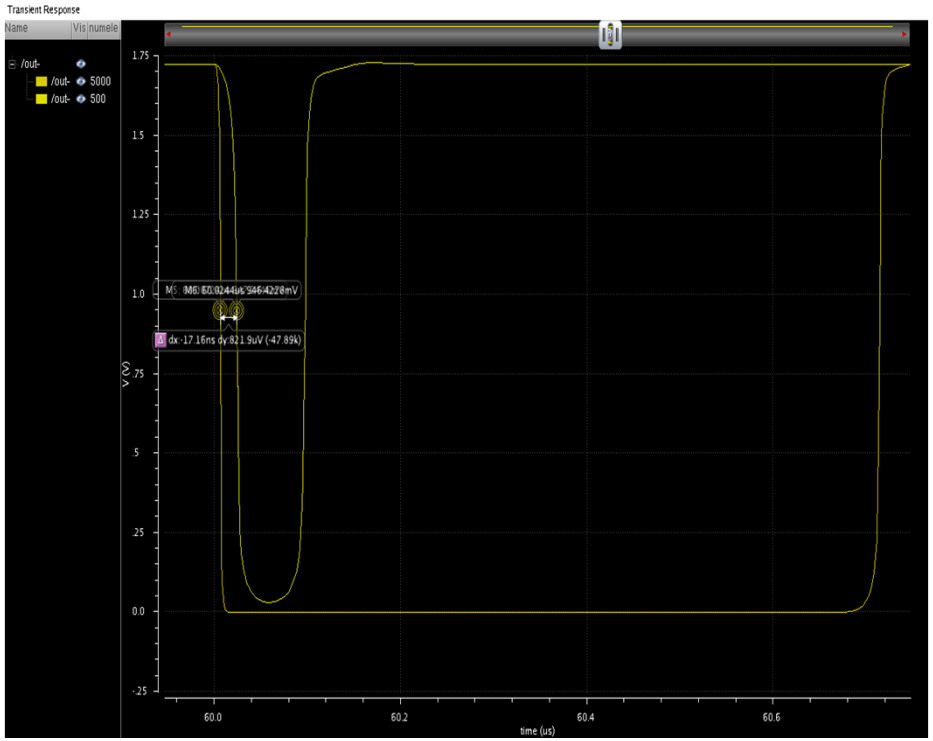
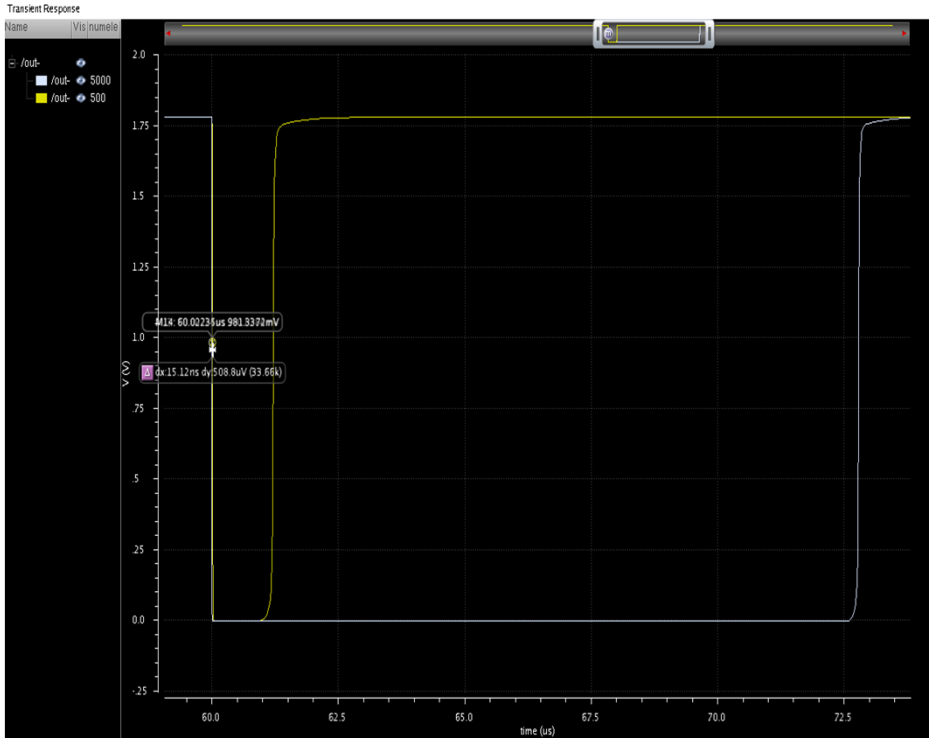
Time-Walk at different Temp Nominal Corner





T = +40°
Time-Walk = 17ns

T = -40°
Time-Walk = 15ns

- Comparator output for 500e- and 5Ke- with threshold set at 275e-
- ~1ns charge injection time

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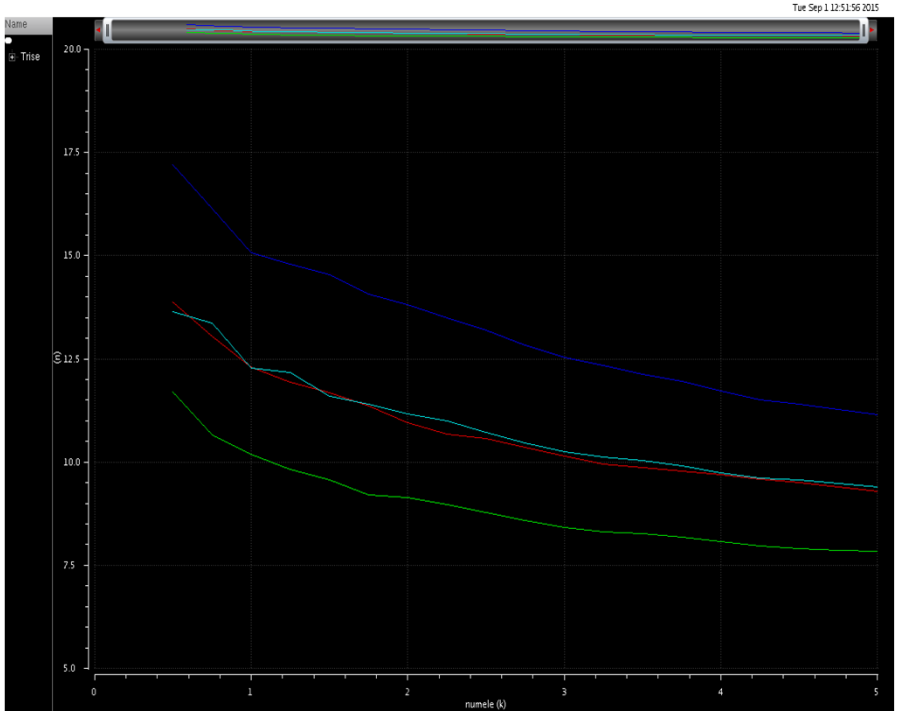
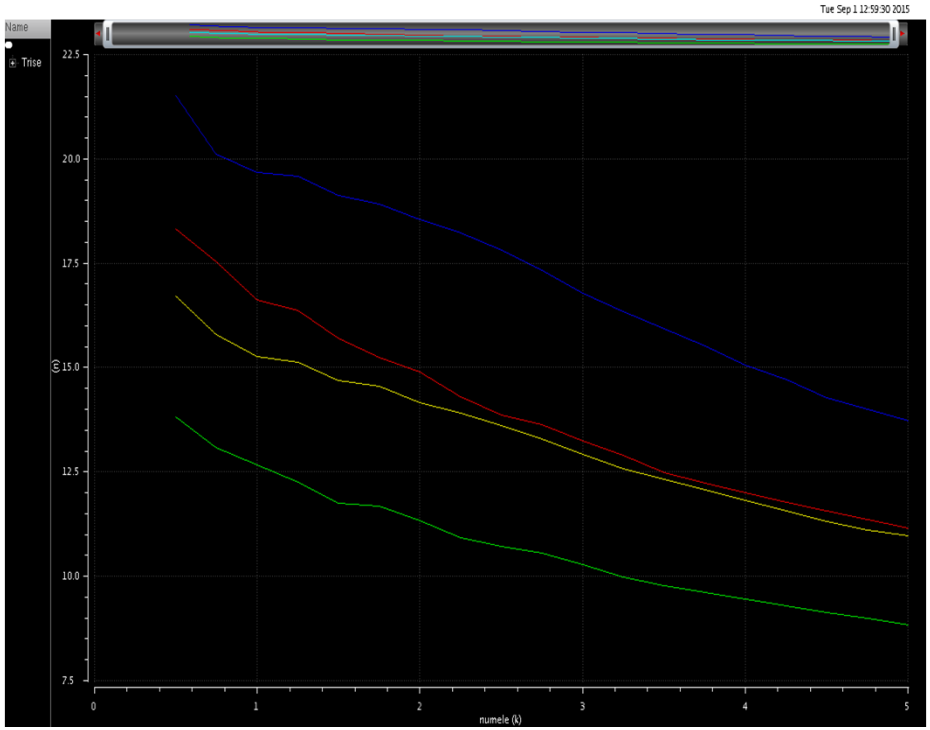
Trise vs signal





T = +40°

T = -40°

- Signal at Pre-Amp output from 500e- to 5Ke- in 250e- steps
- All process corners (NOM, FAST, SLOW, SF, FS)
- Ileakage = 0A
- *Trise increases as Temp decrease*

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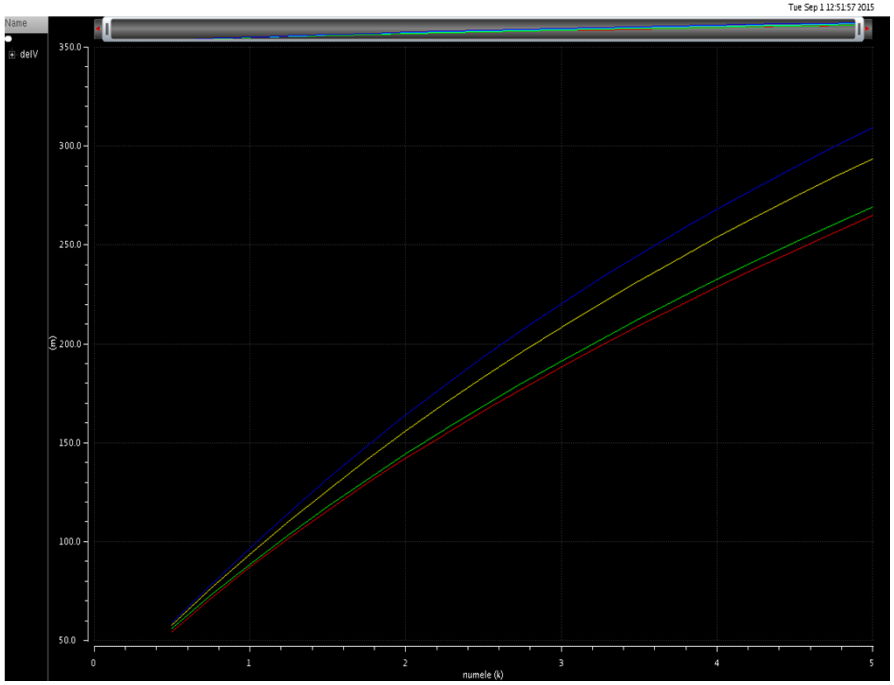
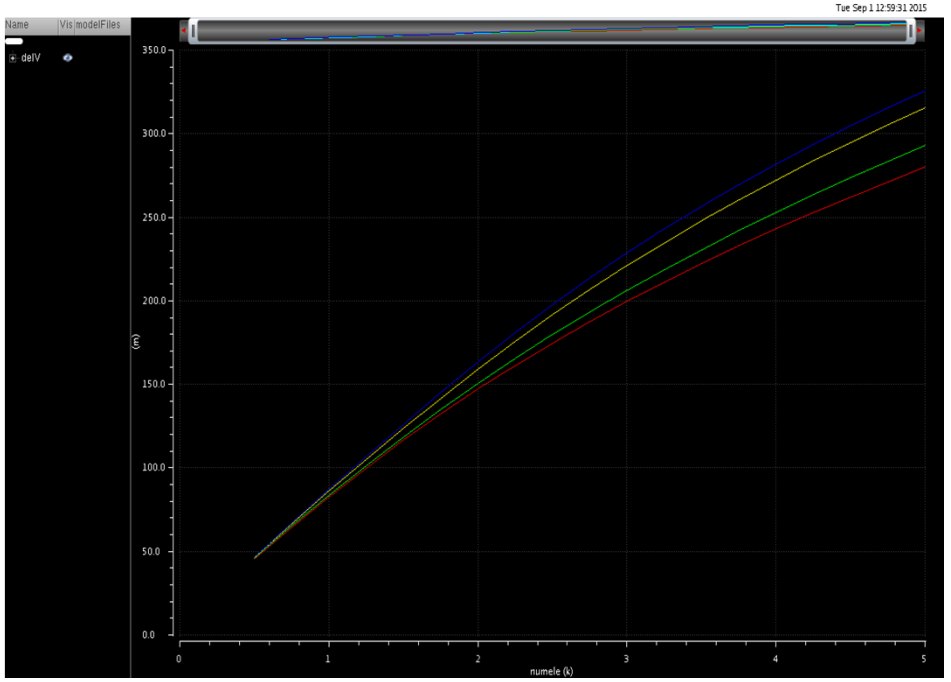
Output pulse amplitude vs signal





T = +40° **T = -40°**

- Signal at Pre-Amp output from 500e- to 5Ke- in 250e- steps
- All process corners (NOM, FAST, SLOW, SF, FS)
- *No significant change in gain*

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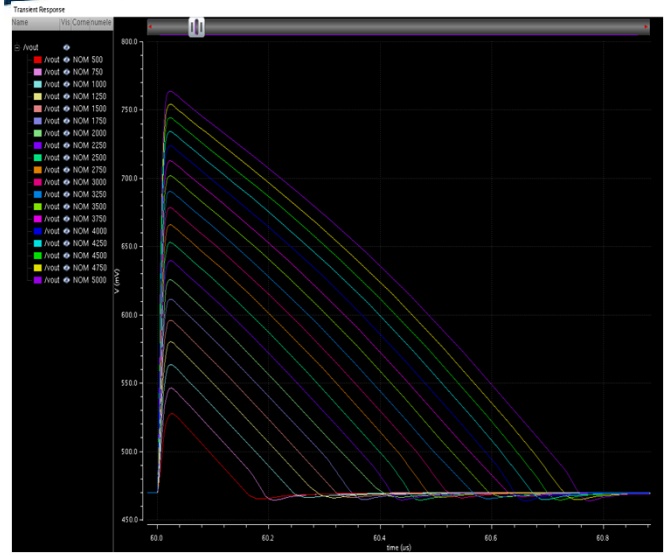
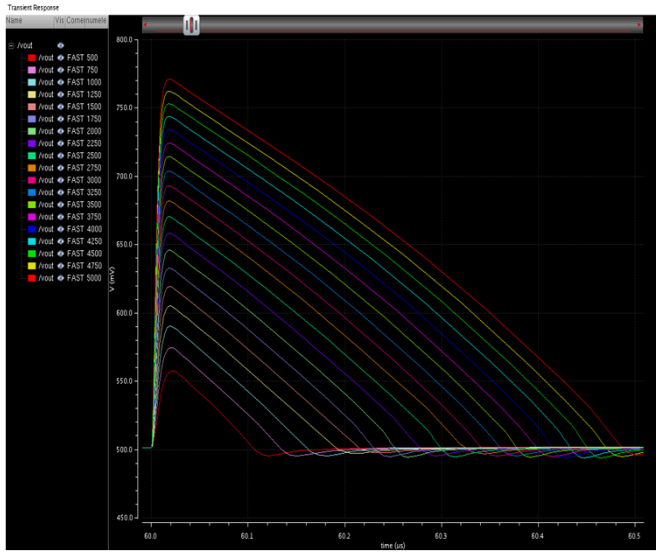
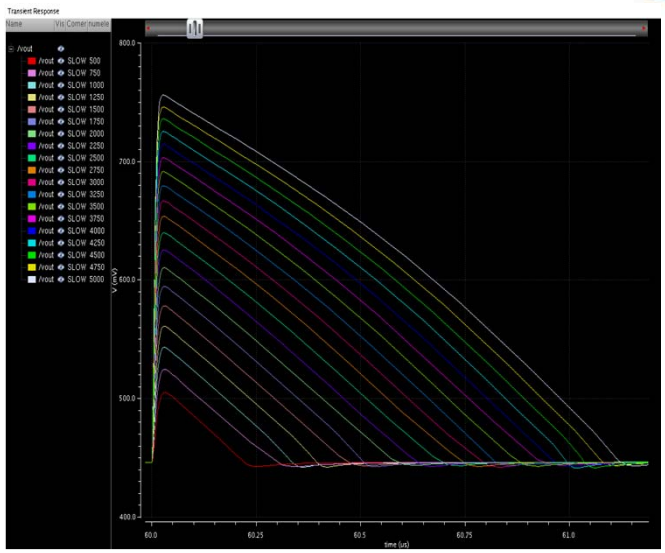
Output pulseshapes vs signal
Temp = +40°



NOM



FAST



SLOW

Signal at Pre-Amp output from
500e- to 5Ke- in 250e- steps
Ileakage = 0A

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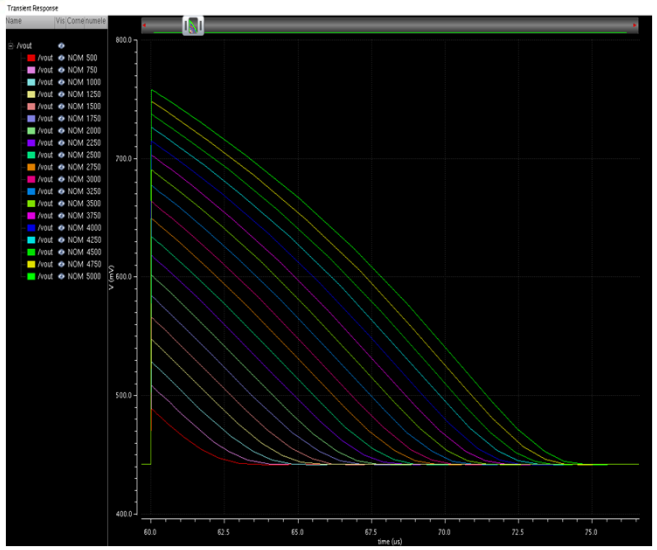
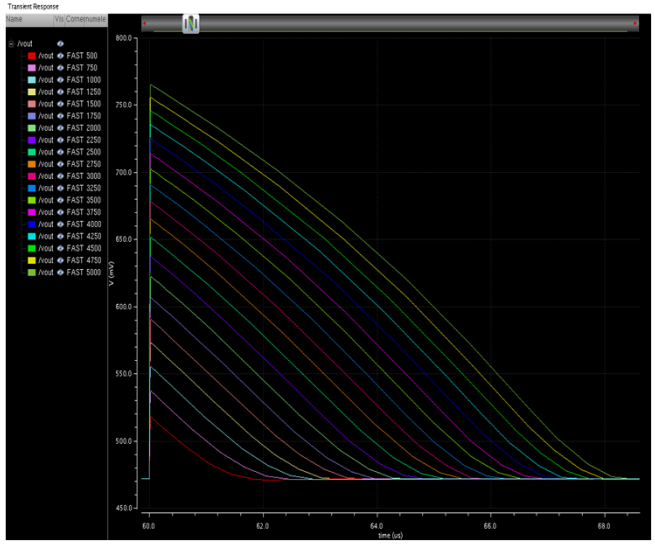
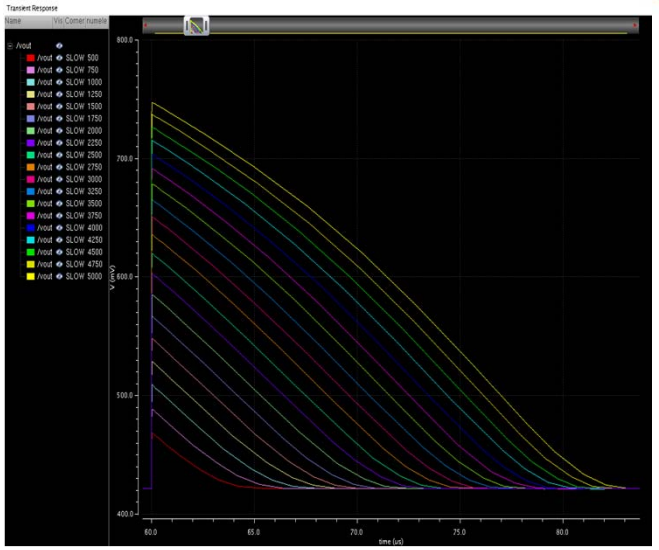
Output pulseshapes vs signal
Temp = -40°



NOM



FAST



SLOW

Signal at Pre-Amp output from
500e- to 5Ke- in 250e- steps
Ileakage = 0A

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Conclusions

- The pre-amplifier seems to be robust across all process corners and temperature extremes

  Leakage current: up to 10nA, also looked at 1uA
  Temperature: -40°C to +40°C
  All functional process corners

- Need to simulate time-walk across all process corners